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PENSOFT

Dipsas vermiculata Peters, 1960 (Squamata, Colubridae): first country record from Colombia, with description of its hemipenial morphology and comments on its distribution and diagnosis

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Abstract

The Vermiculate Snail-eater *Dipsas vermiculata* Peters, 1960 is currently known only from the Amazon region of Ecuador and northern Peru. The present study provides the first record of this species from Colombia, extending its distribution northwards by, approximately, 251 km in a straight line from El Reventador, province of Napo, Ecuador. A detailed description of its fully everted hemipenis is also presented for the first time along with comments on its geographical distribution and identification.

Keywords

Alto Fragua Indi-Wasi, Caquetá, Dipsadinae, Ecuador, Peru.

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Introduction

The snail-eating snakes of the genus *Dipsas* Laurenti, 1768 are distributed in Latin America from Mexico to all South American countries, except Chile (Peters 1960; Peters and Orejas-Miranda 1970; Savage 2002; Wallach et al. 2014). In the latest systematic hypothesis of South American Dipsadini (Arteaga et al. 2018), mainly based on molecular analyses, the genus *Sibynomorphus* Fitzinger, 1843 was considered a synonym of *Dipsas*. This, in addition to other taxonomic actions and new species described from Ecuador and Peru, led to 52 species currently comprised within the genus (Arteaga et al. 2018; Uetz et al. 2019).

Dipsas vermiculata Peters, 1960 is distributed on foothills and lowlands of the Amazon of Ecuador and northern Peru in an altitudinal range of 210–1690 m (Peters 1960; Cisneros-Heredia et al. 2016; Orrell 2019; Pazmiño-Otamendi and Rodríguez-Guerra 2019). This species was initially assigned to the *D. catesbyi* species group mainly based on coloration pattern features (Peters 1960), but Harvey (2008) included it into the *D. temporalis* species group based on additional visceral morphology and scutellation features. Finally, Arteaga et al. (2018) transferred *D. vermiculata* into the *D. variegata* species group based exclusively on the results of their molecular analyses.

In March 2012, a group of students from Universidad del Cauca sampling fauna at Parque Nacional Natural Alto Fragua-Indi Wasi, department of Caquetá, Colombia, collected a single specimen of *Dipsas* that was stored in the herpetological collection of the Museo de Historia Natural of the Universidad del Cauca (MHNUC). A detailed examination of that specimen revealed that it

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represents an individual of *D. vermiculata*, corresponding to the first record in Colombia. The goal of this paper is to report this range extension and to provide additional information on the distribution, morphology, and diagnosis of *D. vermiculata*.

Methods

Species identification is based on the original description by Peters (1960) as well as additional characteristics provided by Harvey and Embert (2008), Arteaga et al. (2018), and distinguishable details of several specimens photographed in life from the Museo de Zoología of the Pontificia Universidad Católica del Ecuador (QCAZ), compiled by Pazmiño-Otamendi and Rodríguez-Guerra (2019). Locality records were also taken from the aforementioned sources in addition to The Global Biodiversity Information Facility (GBIF Secretariat 2019), especially from datasets provided by Harvard University and Senckenberg (Harvard University and Morris 2019; Senckenberg 2019). Since the voucher from MHNUC has no associated coordinates to locality information, I used those provided for "La Quisayá, 800–1600 m" by Gómez-Bernal et al. (2016). All locality records were verified or assigned using Google Earth Pro version 7.3.2.5776. For vouchers lacking coordinates, those were assigned only if there was a specific given locality to the specimen. All coordinates are in WGS84 datum, all elevations in meters above sea level.

Ventral scale count follows Dowling (1951) and subcaudal scales were counted in pairs, excluding the terminal spine. Total and tail lengths were measured with a ruler to the nearest 1.0 mm whilst hemipenial measurements were taken with a dial caliper to the nearest 0.1 mm under a stereoscope. Maxillary teeth were counted on both sides through a narrow incision between the supralabials and the maxillary arch also using the stereoscope. The hemipenis was prepared following the methods of Myers and Cadle (2003) and Zaher and Prudente (2003). Hemipenial terminology follows Dowling and Savage (1960) as supplemented by Myers and Campbell (1981), as well as some of the characters and terms introduced for dipsadines by Harvey and Embert (2008). The organ was photographed with backlight on a glass sheet that was placed on a mirror box, which contained a LED light at its base; a useful technique with which several structures are better appreciable, especially in small organs.

Results

Dipsas vermiculata Peters, 1960

New record. COLOMBIA • 1 adult male; Caquetá, Belén de los Andaquíes, La Quisaya, Parque Nacional Natural Alto Fragua Indi-Wasi; 01.5772, −075.9472; alt. 1100 m; 13 Mar. 2012; collected by Jorge Alberto Zúñiga Baos; MHNUC-HE-Se-0697.

Identification. The specimen MHNUC-HE-Se-0697 (Fig. 1) is identified as *Dipsas vermiculata* according to the following characteristics: an adult male (by presence of hemipenes), slender and laterally compressed body of 591 mm total length, 417 mm snout-vent length, 174 mm tail length (29.4% of total length); prefrontals fused into a single scale, loreal enters orbit, loreal rectangular and less than twice as long as high, preocular one, postoculars three, temporals 2+2; supralabials seven, 4th to 6th contacting eye orbit; infralabials eight, fist pair in contact behind mental, 1st to 5th (right side) and 1st to 6th (left side) in contact with anterior chinshields; chinshields in four pairs, prevental one, ventrals 187, anal plate entire, paired subcaudals 108; smooth dorsal scales in 13–13–13 rows; maxillary teeth 19, in both sides with a short diastema. Coloration pattern composed by 24 brown to dark brown body blotches, darker on borders, plus 13/15 on tail (right/left side) that are complete anteriorly (bands), alternated posteriorly, separated by light brown interspaces that develop projections at midline of dorsum which connect completely around the midbody to the end of tail, forming a cream line on the vertebral row. Dark blotches are slightly rounded on anterior portion of body but become trapezoidal-shaped (lateral view) on posterior portion of body, where interspaces also become trapezoidal and even triangular. Dorsum of head is dark brown with a cream nuchal band and a strong vermiculation. Most portions of supralabials, infralabials, and ventral surface of head are white with some dark brown spots. Ventral coloration is composed by projections of dorsal blotches, but interspaces are white and extend to first or second dorsal scale rows. Each dark ventral blotch is interrupted by a longitudinal medial clear stripe and white blotches have dark pigment also forming a midventral stripe on first ones. After seven years in preservative, the coloration of the specimen has only slightly faded with respect to that of the live specimen (Fig. 2).

Based on the everted left organ of MHNUC-HE-Se-0697 (Fig. 3), the hemipenis of *D. vermiculata* is a cylindrical and slightly elongate organ of 12.8 mm total length, fully capitated except on the portion near the sulcus spermaticus. Capitulum weakly bilobed and not very bulbous, occupying less than a quarter of the organ's length at level of the pronounced capitular arch (asulcate surface) and around 60% at the level of sulcus spermaticus (sulcate surface), being ornamented exclusively with spinules that are enlarged on anterior margin and form poorly developed calyces, best appreciated at the distal portion on the sulcate surface. The sulcus spermaticus is deep and forks directly in the capitulum near its proximal edge with branches that extend centrolinearly almost to the tips of the lobes. Hemipenis body is covered by two rows of straight spines (from under the free capitular flap) followed by three rows of curves spines, a short asulcate patch and two subequal basal hooks with a medium-sized spine in the middle (asulcate surface). On the sulcate surface the rows are reduced to three sulcate

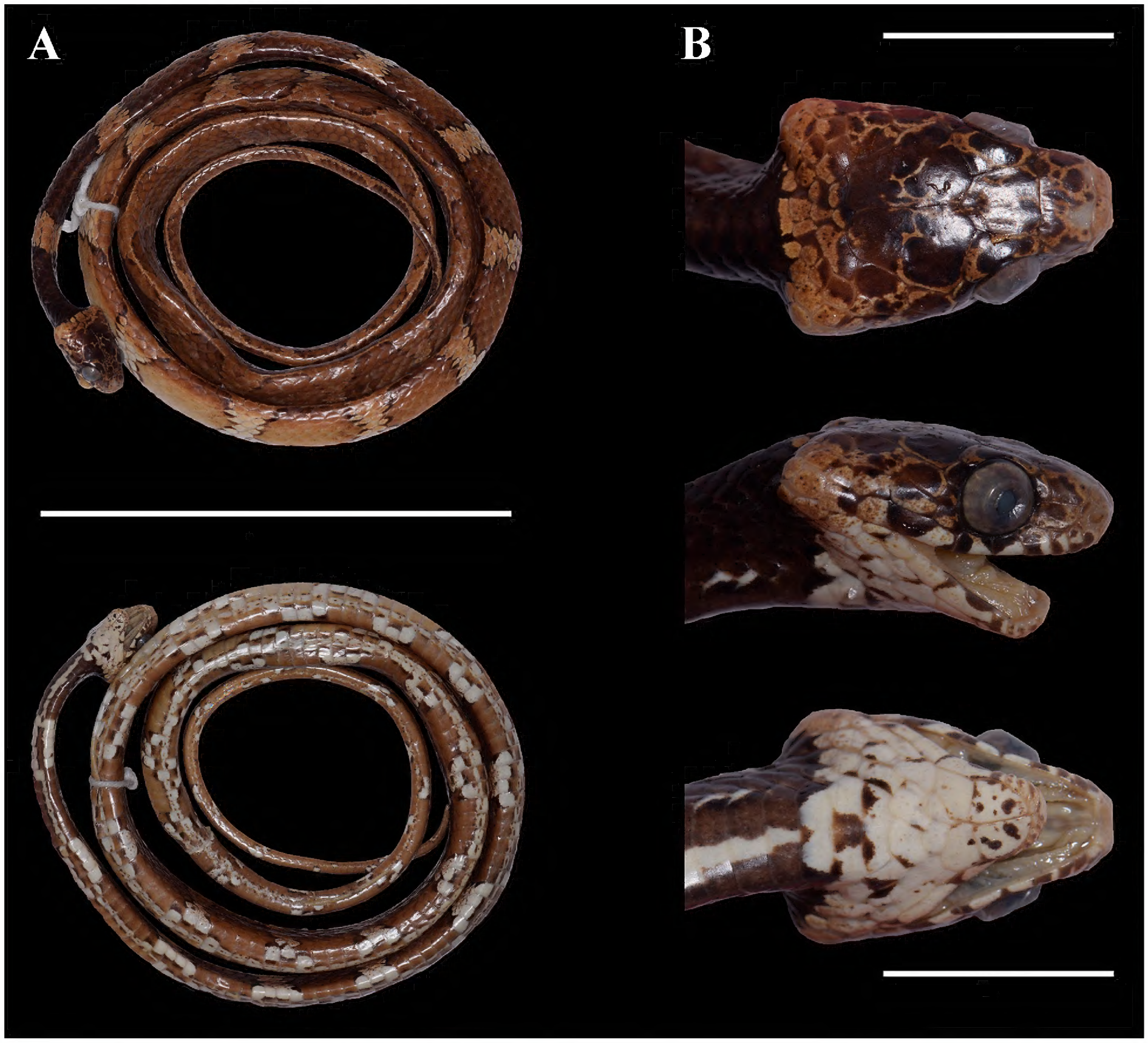

Figure 1. *Dipsas vermiculata* from Colombia (MHNUC-HE-Se-0697) after seven years preserved in 70% ethanol. **A.** General dorsal (upper) and ventral (lower) views. **B.** Head in dorsal (upper), lateral (middle) and ventral (lower) views. Scale bars: A = 80 mm; B = 10 mm.

Figure 2. *Dipsas vermiculata* from Colombia (MHNUC-HE-Se-0697) in life.

spine rows (curved). Lateral offset parasulcal spines are barely longer than basal hooks. Many spinules are present among curved spines, near sulcus spermaticus and the base of organ. An elongate (around 35% of organ length) and deep nude pocket flanked by a pair of fleshy lobes is present on the lateral side between the base of organ and lateral enlarged spines.

Discussion

The new record presented herein is the first documented occurrence of *Dipsas vermicualta* in Colombia and corresponds to the northernmost locality of this species, extending its known distribution in about 251 km in a straight line from El Reventador, province of Napo, Ecuador, to Parque Nacional Natural Alto Fragua Indi-Wasi, vereda La Quisaya, municipality of Belén de los Andaquíes, department of Caquetá, Colombia (Fig. 4). Records from Ecuadorian paratypes AMNH 35960 and UMMZ 89029 listed by Peters (1960) were not mapped

Figure 3. Hemipenis of *Dipsas vermiculata* (left organ of MHNUC-HE-Se-0697). **A.** Sulcate view. **B.** Asulcate view. **C.** Lateral view. Scale bar = 10 mm.

due to "Turula" never having been precisely located by any author (see details in Peters 1957 and Savage 1960), and "Rio Napo watershed" could be any place along the Napo river basin, one of the largest in Ecuador that comprises an altitudinal gradient of more than 5000 m (Lessmann et al. 2016) and an area of 27000 km^2, equivalent to 20% of the eastern part of this country (Laraque et al. 2009). The Peruvian paratype AMNH 55889, likewise, lacks coordinates but those were inferred from the given locality "Far upper Rio Santiago" (−03.5091, −077.7979); whilst the type locality "Chichirota, Ecuador" can be assumed to be the same as for specimen USNM 196350 (−02.3833, −076.65) (Orrell 2019).

The record of the specimen SBH 171139 from Pasco, Peru, incorrectly listed as "SBI 171139" by Arteaga et al. (2018), was excluded from the locality records of *D. vermiculata* (Appendix Table A1) because (1) the locality

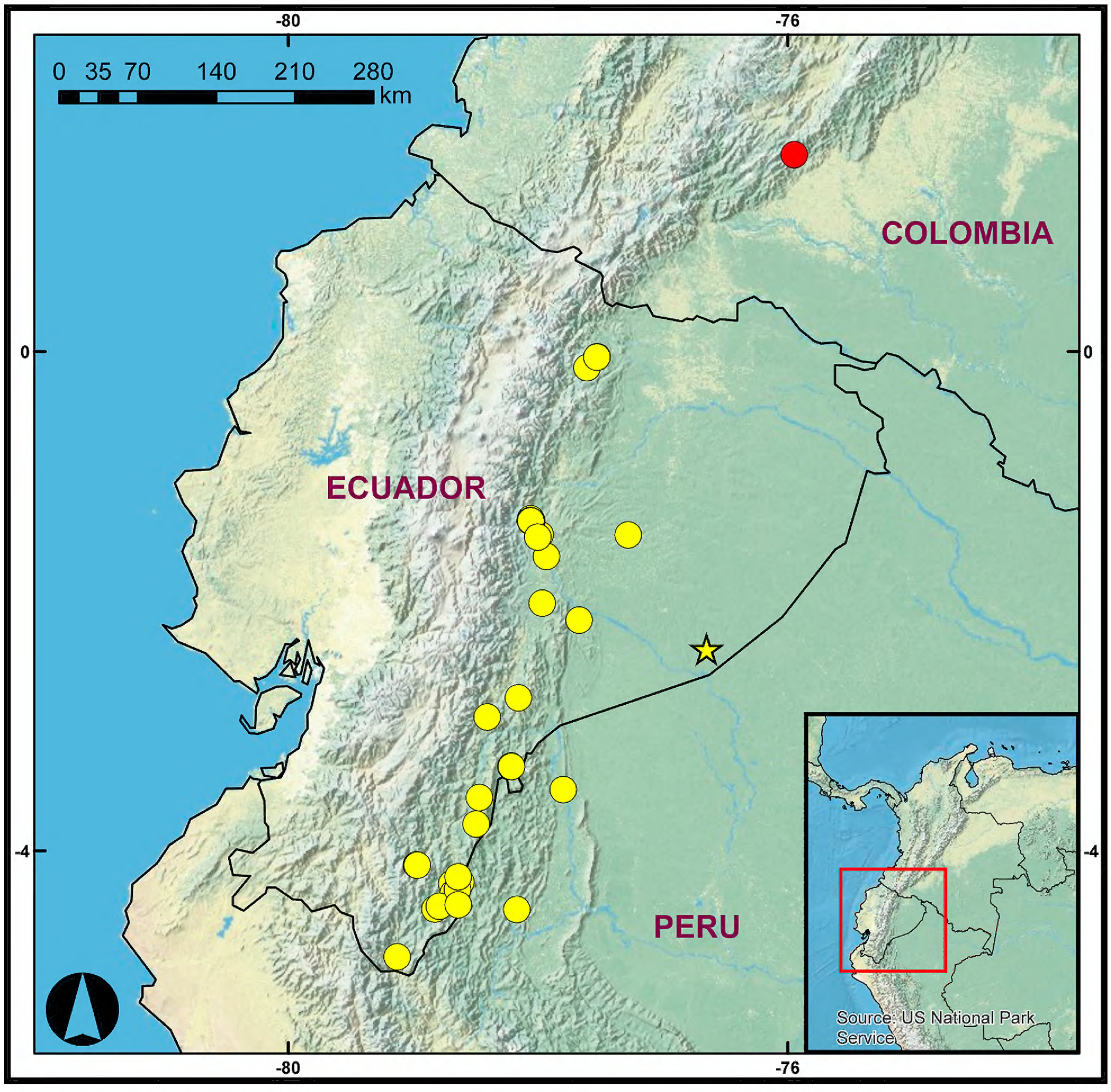

Figure 4. Geographic distribution of *Dipsas vermiculata*. Yellow dots indicate previously published records from Ecuador and Peru. Red dot indicates the new record from Colombia. Star indicates the type locality.

suggests an enormous distribution gap of more than 760 km in a straight line in relation to southernmost records from Ecuador and Peru; (2) the specimen appears initially referenced as *D. catesbyi* (Sentzen, 1796) by Heise et al. (1995); (3) it was not examined and the change of its identity to *D. vermiculata* is only based on DNA sequence analyses; (4) this change was apparently influenced by an inadequate comparison where sequences of 12S gene are lacking for several species of *Dipsas* including the most closely related and/or similar ones such as *D. pakaraima* MacCulloch & Lathrop, 2004, *D. pavonina* Schlegel, 1837, and *D. temporalis* (Werner, 1909) (see Arteaga et al. 2018: appendix 1); and (5) the 12S and 16S gene sequences (GenBank accession numbers Z46459 and Z46496, respectively) associated with specimen SBH 171139 by Arteaga et al. (2018), actually belong to two different specimens (see Material and Methods in Heise et al. 1995).

The specimen MHNUC-HE-Se-0697 has most morphological characteristics diagnoseable for *D. vermiculata* as described in published reviews (Peters 1960; Harvey and Embert 2008; Arteaga et al. 2018), except for 24 dark-bordered dark blotches (vs up to 23 light-bordered) and three postoculars (vs 1–2). However, high–resolution photos in life from Ecuadorian specimens (Pazmiño-Otamendi and Rodríguez-Guerra 2019) reveal that the species can have up to at least 25 dark body blotches (e.g. QCAZ 16201), up to four postoculars (QCAZ 16086, 16201), and "light borders" actually correspond to interspaces. Additionally, some specimens have small subpreocular and temporal scale counts that were not previously reported in literature (3 anterior, 3–4 posterior temporals). A more detailed revision of additional specimens is necessary to improve the description of this species.

Hemipenial morphology of *D. vermiculata* shows high similarity with that described for *D. variegata* (Duméril, Bibron & Duméril, 1854) (Porto and Fernandes 1996; Cadle and Myers 2003). Organs of both species share a slightly elongate shape, a not very bulbous capitulum with some bilobation, lacking papillae and covered only by spinules, a noticeably capitular arch, and 4–5 asulcate spine rows on the body. This similarity further supports the assignment of both species into the same species group as suggested by molecular analyses, and the removal of *D. vermiculata* from the *D. temporalis* group established by Arteaga et al. (2018), as the hemipenis of *D. temporalis* has few asulcate spine rows on the body and papillate calyces uniformly covering the capitulum (Harvey 2008; Harvey and Embert 2008). Likewise, there are notable differences between hemipenial morphology of *D. vermiculata* and *D. pakaraima* (see description in MacCulloch and Lathrop 2004) mainly in terms of the organ shape, capitulum arch, capitulum length, and sulcus spermaticus division, supporting the view that they do not belong to the same species group despite their resemblances in several other characters (Harvey 2008).

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Appendix

Table A1. Locality records of *Dipsas vermiculata*. Sources of coordinates are provided in references. † type locality; ‡ coordinates assigned from a given locality. Modified from Martínez-Fonseca et al. (2019).

Country	Locality	Geographic coordinates		Alt. (m)	Reference	Voucher
		Latitude	Longitude			
Colombia	Caquetá: Belén de los Andaquíes, La Quisaya, PNN Alto Fragua Indi-Wasi	01.5772	–75.9472	1100	This work	MHNUC-HE-Se-0697
Ecuador	Turula	—	—	—	Peters (1960)	AMNH 35960
	Napo river watershed	—	—	—	Peters (1960)	UMMZ 89029
	Morona Santiago: Marantian Wildlife Refuge, Macuma river, 3 km E of Macuma	–02.152	–077.6706	590	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 17367
	Morona Santiago: Lower part of Cordillera de Cutucú	–02.7742	–078.1577	1360	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 16201
	Morona Santiago: Comunidad Shuar Kunkuk, base of Cordillera del Cóndor	–03.3243	–078.2129	1150	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 16084
	Morona Santiago: Comunidad Shuar Kunkuk, base of Cordillera del Cóndor	–03.3203	–078.2146	1060	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 16086
	Morona Santiago: Comunidad Shuar Kunkuk, base of Cordillera del Cóndor	–03.3243	–078.2167	1060	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 16087–88
	Morona Santiago: Limón, Gral. Leonidas Plaza Gutiérrez, 6.6 km N via Macas	–02.9267	–078.407	1000	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 7452
	Morona Santiago: Buffer zone of El Zarza Wildlife Refuge	–03.7843	–078.496	1470	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZR15975
	Morona Santiago: Chiguaza	–02.0167	–077.9667	—	Orrell (2019). https://www.gbif.org/occurrence/1320345587	USNM 210973
	Morona Santiago: ECSA concession	–03.5724	–078.4698	790	Arteaga et al. (2018)	DHMECN 11197
	Napo: Río Salado, 14.7 km (by road) NE of	–00.1289	–077.6083	1310	Orrell (2019). https://www.gbif.org/occurrence/1319979381	USNM 286337
	Pastaza: Llanganates National Park, Zarentza Community	–01.3543	–078.0621	1390	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 13563
	Pastaza: Llanganates National Park, Zarentza Community	–01.3626	–078.0582	1350	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 13564, 65
	Pastaza: Llanganates National Park, Zarentza Community	–01.3587	–078.0511	1340	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 13566

Country	Locality	Geographic coordinates		Alt. (m)	Reference	Voucher
		Latitude	Longitude			
Ecuador	Pastaza: Llanganates National Park, Zarentza Community	−01.3397	−078.0595	1360	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 13567
	Pastaza: Llanganates National Park, Zarentza Community	−01.3593	−078.0574	1330	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 13582
	Pastaza: Santana Field Station	−01.6412	−077.9327	—	Senckenberg (2019). https://www.gbif.org/occurrence/318397025	SMF 90988, 93054
	Pastaza: 1 km W El Puyo	−01.4867	−078.0022	—	Harvard University and Morris (2019). https://www.gbif.org/occurrence/476774914	MCZ R-147184
	†Pastaza: Chichirata (Chichirota)	−02.3833	−076.65	—	Peters (1960), Orrell (2019)	EPN 740, 41; USNM 196350
	Pastaza: Puyo, below, Shilcayacu river	−01.4667	−077.9833	—	Orrell (2019). https://www.gbif.org/occurrence/1322531597	USNM 210972
	Pastaza: Kallana	−01.4696	−077.2784	320	Arteaga et al. (2018)	MZUTI 5080
	Pastaza: Tzarentza	−01.3570	−078.0581	1360	Arteaga et al. (2018)	MZUTI 4738
	Sucumbíos: El Reventador	−00.0448	−077.5286	1480	Arteaga et al. (2018), Pazmiño-Otamendi and Rodríguez-Guerra (2019)	MHNG 2436.014
	Sucumbíos: El Reventador	−00.0412	−077.5268	—	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 666
	Zamora Chinchipe: Las Orquídeas, Tepuy, 4 km from Nangaritza river (barge) towards Tepuy	−04.2632	−078.6911	1840	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 9173
	Zamora Chinchipe: Nangaritza river, Shaime	−04.341	−078.68	1000	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 3723
	Zamora Chinchipe: Cordillera del Cóndor	−04.2503	−078.6174	—	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 7401
	Zamora Chichipe: Parque Nacional Podocarpus, Bombuscaro	−04.1146	−078.967	980	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 13825
	Zamora Chichipe: Parque Nacional Podocarpus, Bombuscaro	−04.1120	−078.9726	1540	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 13826
	Zamora Chichipe: Reserva Natural Maycu	−04.2072	−078.6399	870	Arteaga et al. (2018); Pazmiño-Otamendi and Rodríguez-Guerra (2019)	MZUTI 3663
	Zamora Chichipe: Reserva Natural Maycu	−04.2089	−078.6398	880	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 15422
	Zamora Chichipe: Via Miazi-Nuevo Paraiso	−04.3092	−078.645	1010	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 15423
	Zamora Chinchipe: Surroundings of Ciudad Perdida	−04.4432	−078.7906	1120	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 15735
	Zamora Chinchipe: Surroundings of Ciudad Perdida	−04.4652	−078.8257	1224	Pazmiño-Otamendi and Rodríguez-Guerra (2019)	QCAZ 15736
	Zamora Chinchipe: Nangaritza	−04.4317	−078.6387	1010	Arteaga et al. (2018)	MZUA.RE.0261
	Zamora Chinchipe: 69 km S Vilcabamba	−04.8492	−079.1273	1310	Arteaga et al. (2018)	MHNG 2521.085
Peru	‡Amazonas: Gananashe, Far upper Río Santiago	−03.5091	−077.7979	—	Peters (1960)	AMNH 55889
	Amazonas: Huampami, near Etseketai entse, on the Cenepa river	−04.47	−078.17	210	Orrell (2019)	USNM 316599, 600